INSTRUCTIONS PRELIMINARY GEK-2490(

CONVERSION ASSEMBLY

FOR

DC-3062, DC-3062T & DC-3062R

SCR DRIVES

OPERATION AND MAINTENANCE

MANUAL

GENERAL ELECTRIC

SIMPLIFIED START-UP AND CHECKOUT PROCEDURE

IF ANY DIFFICULTIES ARE ENCOUNTERED DURING START-UP AND CHECKOUT, REFER TO SECTION 4 OF INSTRUCTION BOOK FOR DETAILED START-UP AND CHECKOUT PROCEDURE.

WARNING

ELECTRIC SHOCK CAN CAUSE PERSONAL INJURY OR LOSS OF LIFE. WHETHER THE A.C. SUPPLY IS GROUNDED OR NOT, HIGH VOLTAGES TO GROUND WILL BE PRESENT AT MANY POINTS THROUGHOUT THE DRIVE.

1. VERIFY THAT THE 3-PHASE A.C. POWER INPUT TO THE DRIVE IS OF THE PROPER VALUE AS LISTED ON THE EQUIPMENT DATA NAMEPLATE (–5, +10%).

2. SET TEST REFERENCE POTENTIOMETER TO ZERO, SWITCH No. 1 TO CENTER, SWITCH No. 2 TO CENTER; THIS DISCONNECTS POWER FROM SCR MODULE AND DISCONNECTS ALL REFERENCE INPUTS.

3. APPLY MAIN A.C. POWER TO THE DRIVE SYSTEM. "READY-ON/FAULT-OFF" INDICATOR ILLUMINATES (THE A.C. CIRCUIT BREAKER IN THE TOP HALF OF THE DRIVE SYSTEM MUST BE SWITCHED ON – WHEN SUPPLIED). THIS INDICATOR WHEN ILLUMINATED INDICATES THE FOLLOWING:

   A. THREE PHASE POWER IS APPLIED AND IS IN THE PROPER PHASE SEQUENCE.

   B. DRIVE FUSES ARE NOT OPEN.

   C. MOTOR FIELD IS ENERGIZED AND FIELD LOSS RELAY IS PICKED-UP.

NOTE

IF THE INDICATOR FAILS TO ILLUMINATE, INTERCHANGE ANY TWO TRANSFORMER INPUT PHASES ONCE: IF INDICATOR IS STILL OUT PROCEED TO THE TROUBLE-SHOOTING TABLE 6–1.

4. VERIFY TEST REFERENCE POTENTIOMETER IS SET TO 0, PLACE SWITCH No. 1 TO DOWN AND SWITCH No. 2 TO UP SWITCH POSITION. USE TEST REFERENCE POTENTIOMETER IN CW AND CCW DIRECTION TO VERIFY PROPER MOTOR OPERATION.

5. SET TEST REFERENCE POTENTIOMETER TO 0, SWITCH No. 1 TO UP SWITCH POSITION, SWITCH No. 2 TO CENTER; THIS PROVIDES NORMAL SYSTEM OPERATION.

DC-3062 SIMPLIFIED START-UP AND CHECKOUT PROCEDURE

IF ANY DIFFICULTIES ARE ENCOUNTERED DURING START-UP AND CHECKOUT, REFER TO SECTION 4 FOR DETAILED START-UP AND CHECKOUT PROCEDURE.

WARNING

ELECTRIC SHOCK CAN CAUSE PERSONAL INJURY OR LOSS OF LIFE. WHETHER THE A-C SUPPLY IS GROUNDED OR NOT, HIGH VOLTAGES TO GROUND WILL BE PRESENT AT MANY POINTS THROUGHOUT THE DRIVE.

1. VERIFY THAT THE 3-PHASE A-C POWER INPUT TO THE DRIVE IS OF THE PROPER VALUE AS LISTED ON THE EQUIPMENT DATA NAMEPLATE (-5, +10%).

2. SET "SPEED CONTROL" POTENTIOMETER TO ZERO.

3. APPLY MAIN A-C POWER TO THE DRIVE SYSTEM (THE A-C CIRCUIT BREAKER MUST BE SWITCHED ON - WHEN SUPPLIED). T1, T2 AND T3 FUSE/PHASE INDICATORS ON THE POWER MODULE ILLUMINATE, ALSO THE "READY TO RUN" INDICATOR ON THE DRIVER ILLUMINATES.

   IF THE "READY TO RUN" INDICATOR FAILS TO ILLUMINATE, PROCEED AS FOLLOWS:

   A. CHECK THAT NO INDICATOR LIGHTS ON THE MONITOR CARD ARE ILLUMINATED EXCEPT THE "SYS" INDICATOR.
   B. REMOVE ALL A-C POWER TO THE DRIVE AND INTERCHANGE ANY TWO OF THE THREE A-C PHASE INPUT LINES ONCE. RE-APPLY A-C POWER; IF THE "READY TO RUN" INDICATOR IS STILL OUT, PROCEED TO THE TROUBLESHOOTING TABLE 6-1.

4. WHILE OBSERVING THE MOTOR SHAFT FOR PROPER DIRECTION OF ROTATION, PRESS THE START BUTTON AND TURN THE SPEED CONTROL POTENTIOMETER CLOCKWISE UNTIL SHAFT JUST BEGINS TO ROTATE. IMMEDIATELY PRESS STOP BUTTON. IF INCORRECT MOTOR ROTATION IS OBSERVED, SWITCH OFF ALL POWER AND REVERSE THE ARMATURE LEADS (A1 & A2) AT THE MOTOR TERMINALS.

5. IF TACHOMETER FEEDBACK HAS BEEN SUPPLIED, WITH A VOM (VOLT-OHMMETER) CONNECTED TO READ +20V BETWEEN SFB (SYSTEM FEEDBACK) AND COM AND WHILE OBSERVING THE VOM, PRESS THE START BUTTON AND VERIFY THAT A POSITIVE VOLTAGE IS PRESENT WHEN SHAFT IS ROTATING. PRESS THE STOP BUTTON. IF VOLTAGE WAS NOT POSITIVE REVERSE THE TACHOMETER LEADS AT THE POWER UNIT TERMINAL BOARD. RETURN SPEED CONTROL TO ZERO.

6. TURN SPEED CONTROL POTENTIOMETER FULLY CW. ADJUST SMAX (SYSTEM MAXIMUM) FOR DESIRED MAXIMUM MOTOR SPEED. PRESS THE STOP BUTTON. *

7. WITH SPEED CONTROL FULLY CW MEASURE (IN SECONDS) THE ACCELERATION TIME FROM ZERO TO TOP SPEED WHEN THE START BUTTON IS PRESSED. ADJUST FOR DESIRED ACCELERATION TIME USING THE TIMR (TIME RANGE) POTENTIOMETER.

8. WHEN AN APR (AUXILIARY PRESET REFERENCE) SUCH AS JOG OR THREAD HAS BEEN SUPPLIED PUT THE DRIVE IN APR MODE AND PRESS THE START BUTTON AND ADJUST THE APR POTENTIOMETER FOR THE DESIRED SPEED. PRESS THE STOP BUTTON.

* Omit if regulator card is not furnished.

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SECTION I
GENERAL

1.1 SCOPE OF MANUAL

This instruction manual is structured around a basic system. It is a guide for the installation, check-out and operation of the equipment, furnished with general troubleshooting procedures for the basic system. Any special purpose equipment, as requested on the requisition, will normally be covered in the schematic drawings included with this package. If special purpose equipment is added to the Troubleshooting or Description of Equipment section, it will be so noted by an asterisk. These instructions do not purport to cover all details or variations in the equipment nor to provide for every possible contingency in connection with the installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purpose, the matter should be referred to the General Electric Company.

1.2 SAFETY, PERSONNEL AND EQUIPMENT

The following paragraphs list some general safety reminders and safety recommendations to be followed when operating this equipment.

Only trained electrical and electronics personnel should install and maintain this equipment. It is dangerous to the untrained or unskilled.

Definition of terms and sign colors:

WARNING: Denotes operating procedures and practices that may result in personal injury or loss of life if not correctly followed.

Color: Black or white lettering on red field.

CAUTION: Denotes operating procedures and practices that, if not strictly observed, will result in damage to, or destruction of, the equipment.

Color: Black lettering on amber field.

NOTE: Denotes an operating procedure or condition that should be highlighted.

Color: Black lettering on white field.

WARNING: HIGH VOLTAGE

ELECTRIC SHOCK CAN CAUSE PERSONAL INJURY OR LOSS OF LIFE. WHETHER THE AC VOLTAGE SUPPLY IS GROUNDED OR NOT, HIGH VOLTAGES TO GROUND WILL BE PRESENT AT MANY POINTS WITHIN THE SCR DRIVE. EXTREME CARE MUST BE EXERCISED IN THE SELECTION AND USE OF TEST INSTRUMENTS. OPERATOR SHOULD NOT STAND ON GROUNDED SURFACES OR BE IN CONTACT WITH GROUND WHEN APPLYING TEST INSTRUMENTS TO TEST POINTS. CONVENTIONAL TEST INSTRUMENTS SHOULD NOT HAVE CHASSIS GROUNDED WHILE TESTS ARE BEING MADE THUS THE CHASSIS CAN BE AT A HIGH VOLTAGE WITH RESPECT TO GROUND DURING TESTING. EXTREME CARE SHOULD BE TAKEN WHILE ATTEMPTING TO ADJUST, TROUBLESHOOT OR MAINTAIN ANY DRIVE SYSTEM DESCRIBED HEREIN.

When working on or near the equipment with power/voltage applied, it is recommended that all metal objects such as rings, watches and tie clasps be removed.

It is highly recommended that all personnel working on this equipment wear rubber soled shoes (insulated).

WARNING

WHEN WORKING AROUND ROTATING EQUIPMENT, DO NOT WEAR ANY LOOSE CLOTHING THAT COULD BECOME CAUGHT IN THE EQUIPMENT.

CAUTION

DO NOT INSERT OR REMOVE PRINTED CIRCUIT CARDS FROM THE EQUIPMENT WHILE POWER IS APPLIED OR OPERATING: THIS CAN DAMAGE THE EQUIPMENT.

NOTE

ALWAYS READ THE COMPLETE SUBSECTION (EXAMPLE 3-2) PRIOR TO ANY TURN-ON OR TROUBLESHOOTING OF THE EQUIPMENT, FOLLOW THE PROCEDURE STEP-BY-STEP.

READ AND HEED ALL WARNING, CAUTION AND NOTE SIGNS POSTED ON THE EQUIPMENT.

1.3 SHIPPING

1.3.1 Receipt of Shipment

All equipment is factory inspected before shipment and is shipped in good condition. Any damages or shortages evident when the equipment is received must be immediately reported to the commercial carrier who transported the equipment. If required, assistance may be received from the General Electric Company, Speed Variator Products Department, but when seeking assistance, please use the purchase order number, requisition number and model number to help us in assisting you.

1.4 RECEIVING, HANDLING AND STORAGE

1.4.1 Receiving

The equipment should be placed under adequate cover immediately upon receipt as packing cases are not suitable for out-of-doors or unprotected storage.

1.4.2 Handling

Smaller power units, wall mounted, can be transported by lift trucks with forks completely under the base. All smaller power units have two detachable screw-in eyelets at the top, for lifting by crane. The larger floor-mounted power unit bases have two lifting holes on each side, so that a pipe may be slipped through each pair and crane hooks be used to pick up the unit by means of the pipes. The holes in the power unit may also be used for receiving crane hooks. Spreader bars should be used to spread the cables above the cabinet and bumpers should be used wherever hooks or cables may come into contact with the cabinet, to prevent damage to the cabinet metal and painted surfaces.

1.4.3 Storage

If the equipment is not to be installed immediately, it should be stored in a clean, dry location that is not subject to extreme temperatures. Precautions should be taken to prevent moisture from accumulating in the equipment. The entrance of moisture, dust or dirt during storage or installation is detrimental to the equipment. For more detailed information on environmental factors, see GEK-24902.

SECTION II
SYSTEMS EQUIPMENT DESCRIPTION

2.1 EQUIPMENT PURPOSE

This DC adjustable speed drive is a closed loop, adjustable speed unidirectional, adjustable acceleration system designed for coordinated lines, machine tool control and general purpose systems. The basic system normally consists of three basic parts:

1. DC Motor
2. Power and Control Unit
3. Operator Station

2.2 EQUIPMENT FURNISHED - GENERAL

For the exact description of equipment received, refer to your order data, and system elementary diagrams.

2.2.1 DC Motor - 30 to 250 horsepower, shunt wound, separately excited field, 240VDC or 500VDC armature, maximum ambient 40C, thermostat protection.

2.2.2 Power and Control Unit - 230, 460VAC, three phase, 60Hz power input; SCR full wave bridge, six pulse conversion with adjustable voltage from zero to 240VDC or 500VDC; open panel, wall or floor mounted enclosures.

2.2.3 Operator Station - a remote enclosure housing a speed adjust control, run/start control and stop control, which when connected to the power and control unit, provides operator selection of basic command functions.

2.2.4 Special Purpose Equipment - see System Elementary Diagrams

2.2.5 Control and Indicator Functions

Table 2-1 will give a listing of the controls and indicators and their function. Refer to Figure 2-1, System Block Diagram and Figure 2-2 Location & Function of Driver-Regulator Cards.

TABLE 2-1 FUNCTION OF CONTROLS AND INDICATORS

EQUIPMENT/ITEM	CONTROL/INDICATOR	FUNCTION
Operator Station (if supplied)	Speed Control - 0 to 10 marked range	Provides a means of adjusting the motor speed from zero to top speed after the "RUN" relay has been energized.
	Forward-Reverse selector switch (modification)	Provides a means of changing the direction of motor rotation when at zero speed.
	Run-Jog selector switch or Start pushbutton. (If supplied)	This is a dual function switch; it provides the means of selecting either the RUN or JOG (APR) mode and then by activation energizes the selected function. When the "RUN" mode is selected, by momentarily activation, the "RUN" circuit is sealed in. In the "JOG" mode the activation must be held depressed during the time required for the "JOG" function.
	Stop Pushbutton	Interrupts the 115 vac to the RUN relay coil which de-energizes, causing the armature loop to open; removes the speed input signal and shuts down the drive system.
IC Driver Regulator	READY TO RUN (Push-to-Reset) pushbutton indicator light	Illuminates (green) when incoming three phase power is on and in the correct phase sequence and no other "faults" are in the system (Ready to Run). The reset function resets the monitor which energizes the fault relay coil if the problem was of a transient nature or the problem has been corrected.
Standard Regulator Card (if (G) supplied)		This card provides the regulating functions and adjustments normally required in a complete one quadrant regulator system. *
	RESP (Response) potentiometer	Provides an adjustment of system sensitivity for stability and response.

* Omit if regulator card is not furnished.

TABLE 2-1 FUNCTION OF CONTROLS AND INDICATORS

EQUIPMENT/ITEM	CONTROL/INDICATOR	FUNCTION
	SMAX (System Maximum) potentiometer	Provides an adjustment range to set the system maximum speed in conjunction with jumper range selection.
	ILIM (Current Limit) potentiometer	Provides an adjustment range for overcurrent protection; normally set at 150% of full load current.
	LREG or COMP (Load Regulation) potentiometer	Provides an adjustment to compensate for IR drop when the system is operating as a armature voltage regulator.
	DAMP (Motor Root Damping) potentiometer	Provides an adjustment to improve motor stability.
	TIM+, TIM- (Timing adjust) potentiometers	Provides an adjustable range, in seconds, for acceleration or deceleration of the system to the speed (RPM) requested by the reference signal. Normal adjustment range is 3 to 30 seconds for zero to full scale input.
	APR (Auxiliary Preset Reference) potentiometer	Provides an adjustment range of 0 to 30% for the preset reference voltage for a "thread or jog" type function. This auxiliary preset reference is additive to the system reference.
Driver Coordination Card (F)		This card provides the ±15V and +5V power, ±20V delay circuit, voltage feedback isolation & amplification, driver voltage regulation, driver current limit and istantaneous over current (IOC) detection.
	VLIM (Voltage Limit adjustment)	Adjusts the maximum voltage that can be applied to the motor.

*

* Omit if regulator card is not furnished.

TABLE 2-1 FUNCTION OF CONTROLS AND INDICATORS

EQUIPMENT/ITEM	CONTROL/INDICATOR	FUNCTION
Monitor card (E)		Provides the circuitry to initiate a drive shutdown when a fault occurs and indicates the class of fault that occurred. It also provides test connection points of significant signals for monitoring with test equipment.
	SYS (System trip) indicator	Provides a visual indication (lights) that a system class fault has occurred such as: Loss of phase Incorrect phase sequence DC Power Module fuses (if supplied) open Auxiliary fault monitoring devices in system trip circuit.
	IOC (Instantaneous overcurrent) indicator.	Provides a visual indication (lights) that the IOC circuit has actuated due to a instantaneous overcurrent condition.
	TEMP (Temperature) indicator	Provides a visual indication (lights) that the power module thermal switch has actuated due to a over tempature condition.
	OIP (Initial pulse)	Provides a means to monitor with an oscilloscope the outputs of the phase control cards.
	DERR (Driver error)	Provides a means to monitor the amplified difference between the driver reference and the voltage feedback.
	+5V test point	Provides a means of monitoring the +5 power supply (+4 to +6V).
	SR (System reference) test point.	Provides a means of monitoring the system reference input (speed ref command normally 0 to +20V). *
	TR (Timed Reference) test point.	Provides a means of monitoring the time reference signal as adjusted by the TIMR potentiometer (0 to -10V) which controls system acceleration and deceleration time.

* Omit if regulator card is not furnished.

TABLE 2-1 FUNCTION OF CONTROLS AND INDICATORS

EQUIPMENT/ITEM	CONTROL/INDICATOR	FUNCTION	
Monitor card cont'd.	SFB (System Feedback) test point.	Provides a means of monitoring the scaled system feedback, tachometer signal if speed regulator (0 to +10V)	*
	DR (Driver Reference) test point.	Provides a means of monitoring the driver reference input (0 to +10V)	
	CFB (Current Feedback) test point.	Provides a means of monitoring the scaled current feedback (0 to +2.5V) from the DC Power Module.	
	1CST (Zero Current Stop) test point.	Provides a means of monitoring the zero current stop command status (0 or +20V). A +20V input will cause the drive to phase back and when zero current is sensed the outputs to the power module are inhibited as long as the +20V is present.	
	VFB (Voltage Feedback) test point.	Provides a means of monitoring the scaled voltage feedback (0 to -5V) from the output of the DC Power Module.	
	PCR (Phase Control Reference) test point.	Provides a means of monitoring the phase control reference (0 to +7V)	
	SEL (Select) test point.	Provides a means of monitoring a factory selected function, normally connected to signal OIP (initial pulse).	
	SYNC (Synchronizing Signal) test point.	Provides a means of monitoring one of the synchronizing signals and also provides a sync signal for an oscilloscope.	
	COM (Common) test point.	Signal common for the above test points.	
Phase Control card (D)	No adjustments, indicators or test points.	This card provides the three-phase power synchronizing detector, and the ramp and pedestal circuit to convert the analog signal from the driver coordination card to six phase shifted digital signals to the gate control card.	

* Omit if regulator card is not furnished.

TABLE 2-1 FUNCTION OF CONTROLS AND INDICATORS

EQUIPMENT/ITEM	CONTROL/INDICATOR	FUNCTION
Gate Control card (C)		This card provides the oscillator and the buffers to drive the pulse transformers cards in the SCR module. It receives its signals from the phase control card. Twelve test points are located on the front of this card to monitor the outputs to the pulse transformer cards. One quadrant drives only use the forward output pulses.
	1F1 thru 1F6 and 1R1 thru 1R6 test points.	Provides a means of monitoring the forward and reverse firing pulses to the pulse transformer cards in the power module(s).
20V Power Supply card (B)		This card provides the regulated + and -20V DC required for driver operation. Its input is unregulated ± 30V DC from the power supply rectifier card located in the driver power assembly. Two test points are located on the front of this card to monitor the ±20V DC outputs. Two fuses, one each for the ±20V DC outputs are located on the front edge of this card. Two spare fuses are also mounted on the card.
	+20V test point.	Provides a means of monitoring the +20V power supply (+19.8 to +20.2V).
	-20V test point.	Provides a means of monitoring the -20V power supply (-19.8 to -20.2V).
	COM (Common) test point.	Power supply common for the above two test points.
Driver Power Assembly (DPA)		This assembly provides the high impedance isolation between high voltage signals and the driver. It also provides ±30VDC to the driver from stepped down and rectified 115VAC input. It is attached to the bottom of the card rack.

TABLE 2-1 FUNCTION OF CONTROLS AND INDICATORS

EQUIPMENT/ITEM	CONTROL/INDICATOR	FUNCTION
Power Module Assembly		This assembly contains the SCR's, suppression circuits, pulse-transformer cards and current feedback card which converts the three phase a-c input to an adjustable d-c output level for motor armature control.
	T1,T2 & T3 Indicator Lights	Provides a visual indication (lights) when each phase of the three phase power is present in the power module. Also detects an a-c input fuse failure.

2.3 BASIC SYSTEM THEORY OF OPERATION

To understand the theory of operation, first the requirements of the drive system must be stated. The drive system must be able to perform the following:

Convert a-c power to d-c power
Start and stop motor
Control motor speed through its designed speed range.
Sense and correct motor needs (loads)
Protect the system
Provide accurate and smooth operation of the motor
Monitor and control itself
Provide special acts or needs

The basic system block diagram is shown in Figure 2-1.

The system will be divided into five functional areas; Power, command and Logic, Driver,Regulator, Power Module and Motor.

2.3.1 Power

The three phase a-c power is brought through the three ac input fuses (or circuit breaker) and into the power module for conversion to d-c power. The a-c also supplies power to the Driver Power Assembly (DPA), the field supply and the control power thansformer (CPT). The DPA provides isolated three phase synchronization voltage to the driver, $\pm$ 30V for driver regulator use (115VAC from CPT rectified) and the dc voltage feedback from the power module.

2.3.2 Command and Logic

The external command and logic circuitry (relays, switches and protective devices) is responsible for the starting, stopping, direction, protection and speed reference (REF) input to the system.

2.3.3 Driver with Standard Regulator Card

The basic driver regulator is composed of six plug in printed circuit cards plus the DPA. These cards are individually keyed to prevent insertion in the wrong location or incorrect orientation. Its task is to receive the reference input and coordinate and deliver firing signals to the power module. The driver regulator, after reacting to the command, must then monitor the power module and motor performance, by the way of feedback signals (fdbk) and maintain and input reference request. When the input reference changes, the driver regulator must provide the power module with the new command signal. It also provides system protection such as current limit and overcurrent trip (IOC). For the complete description reference Table 2-1 Function of Controls and Indicators.

2.3.4 Power Module

The power module consists of three identical sub-assemblies (one per phase) each consisting of one dual channel pulse transformer card and two SCR's on a heatsink assembly. The module also contains a current feedback card, ac suppression circuits, thermal protection and phase indicating lights (three) which provide ac input fuse failure information when fuses are supplied. The three phase a-c power into the module is converted to the proper d-c power level by the SCR's. The power conversion circuit is a three phase, full wave bridge, each of its six legs containing a silicon controlled rectifier (SCR). The output voltage is controlled by means of SCR gate pulse signals from the driver.

2.3.5 DC Motor

The motor will react to the amount of voltage and current from the power module providing power across its speed range. The motor field supply is provided by a constant potential exciter on base speed drives.

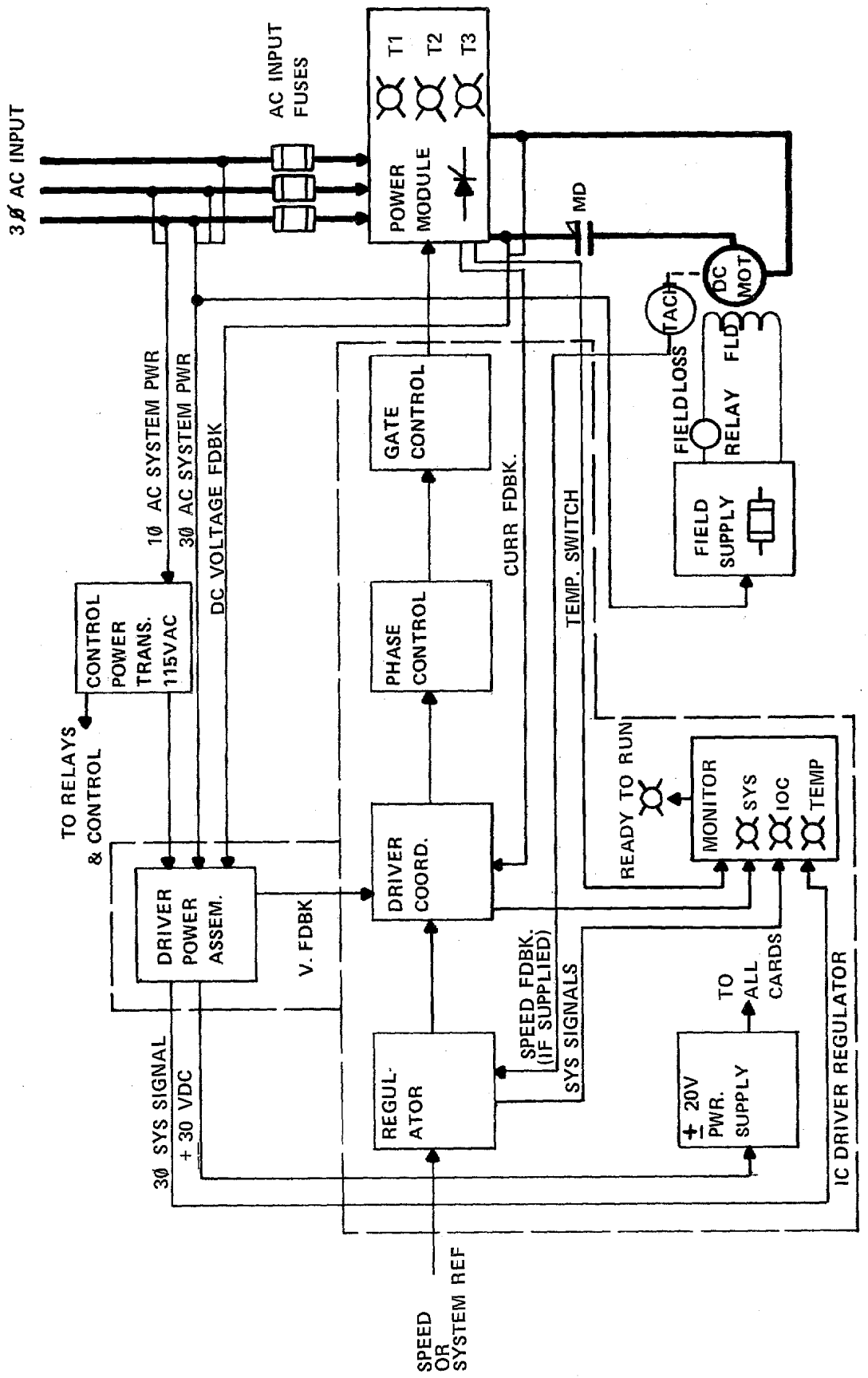


FIGURE 2 – 1 DC-3062 SIMPLIFIED SYSTEM BLOCK DIAGRAM
(ONE QUADRANT WITH STANDARD REGULATOR CARD)

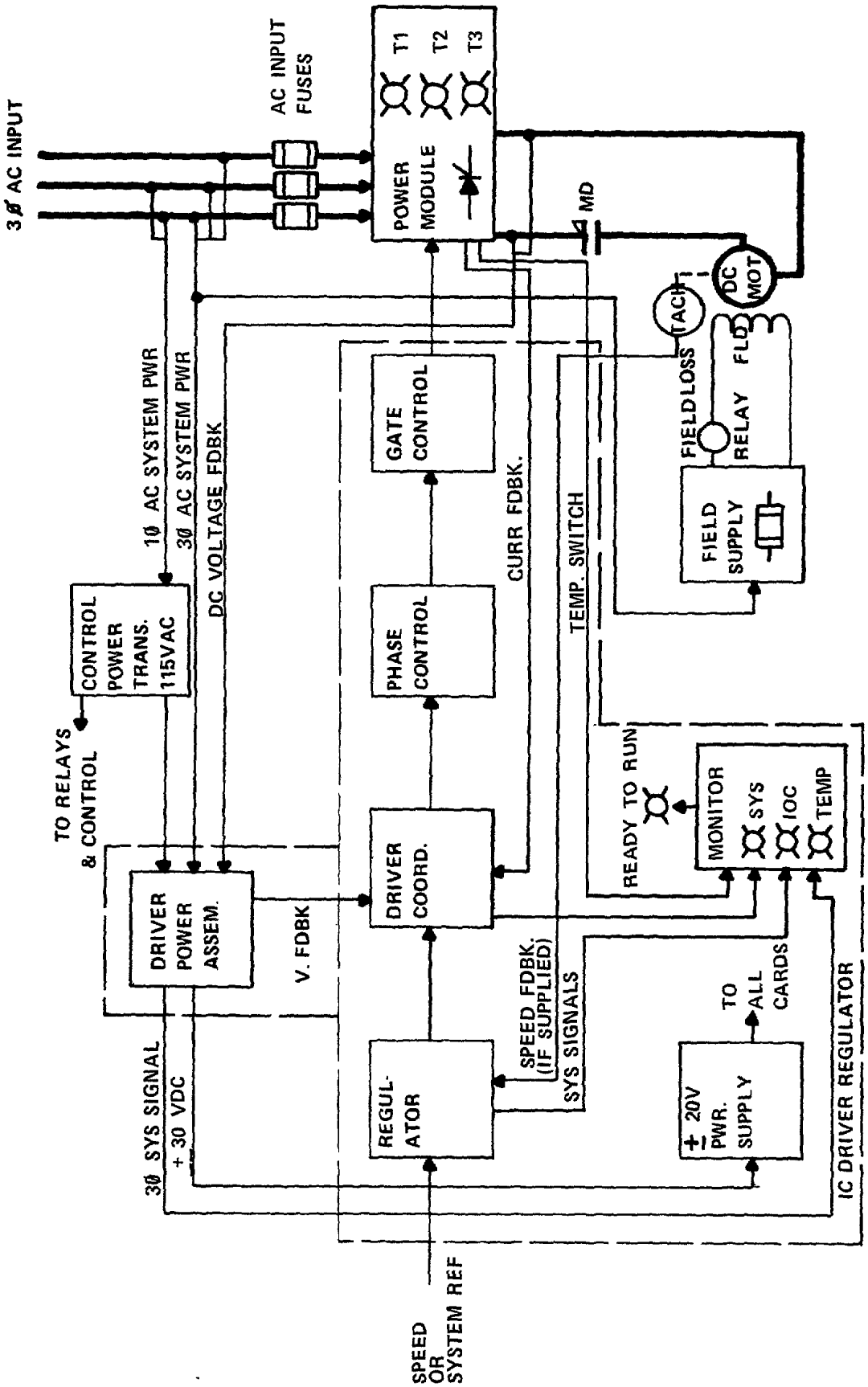
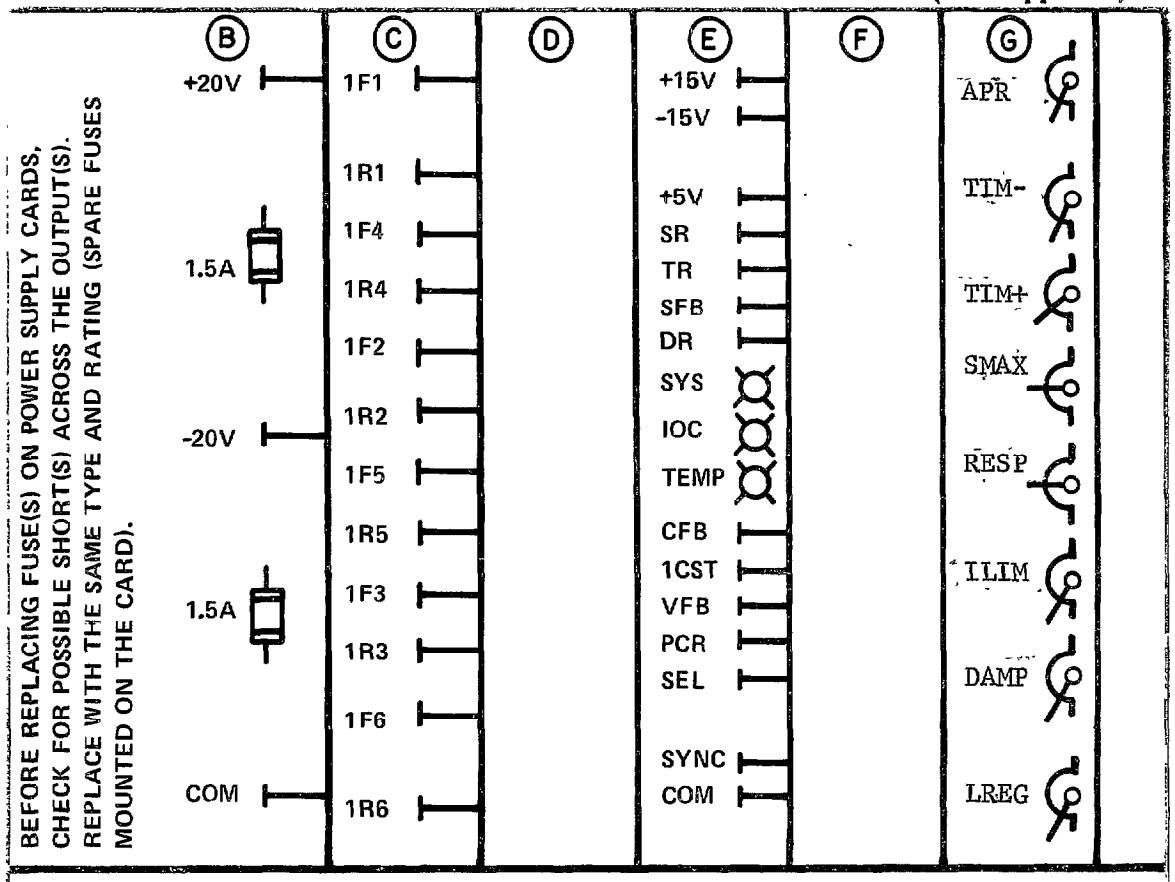


FIGURE 2 – 1 DC-3062 SIMPLIFIED SYSTEM BLOCK DIAGRAM
(ONE QUADRANT WITH STANDARD REGULATOR CARD)

(if supplied)



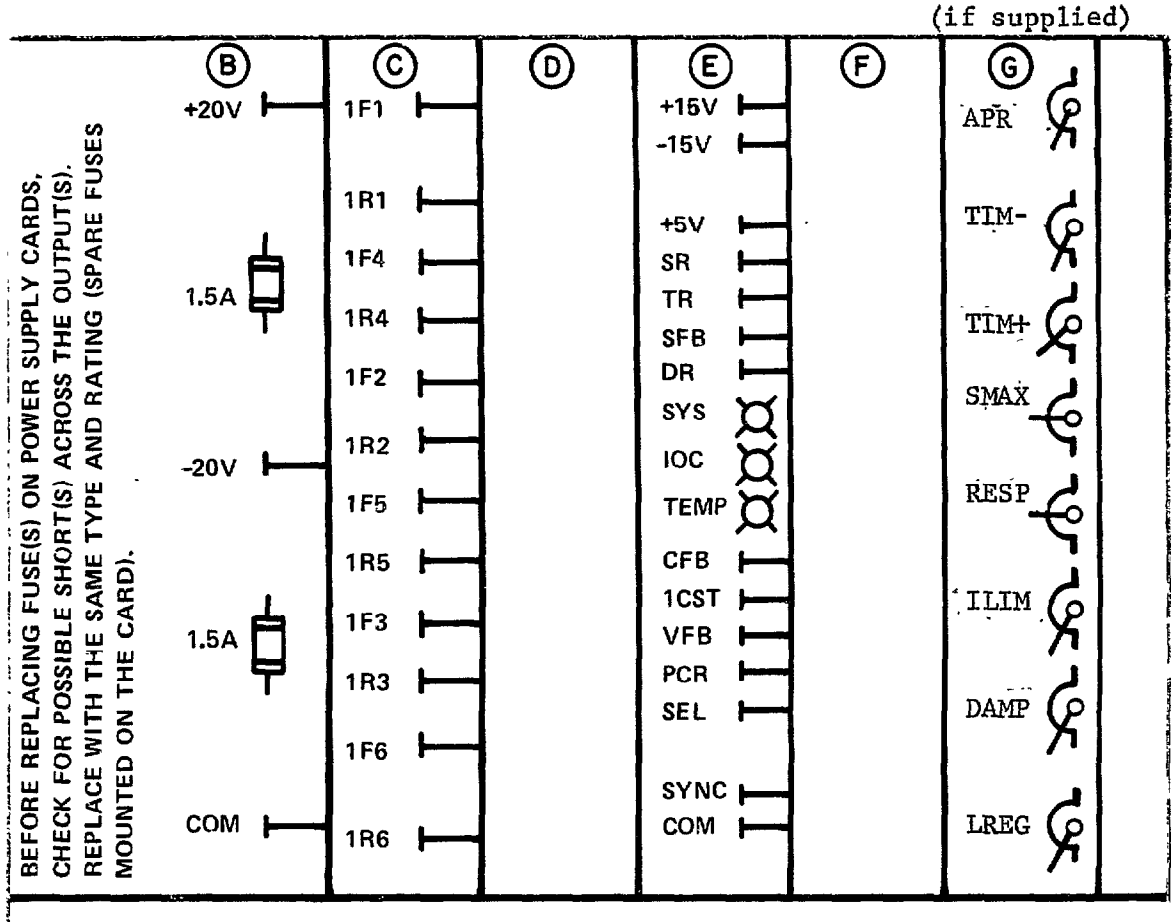
NP104X905BA139

LOCATION	NAME	CAT. NO.
B	20 VOLT POWER SUPPLY	193X257AAG01
C	GATE CONTROL	193X262AAG01
D	PHASE CONTROL	193X259AAG01
E	MONITOR	193X261ABG01
F	DRIVER COORDINATION	193X260BAG01
G	STANDARD REGULATOR	193X267BAG01

ON PRINTED CIRCUIT CARDS USED IN THIS REGULATOR THE LETTERS "AA" AFTER THE BASIC CARD CATALOG NUMBER INDICATES ORIGINAL DESIGN. SUBSEQUENT DESIGNS WITH THE SAME BASIC NUMBERS & GROUP NUMBER WITH THE SECOND LETTER CHANGED, SUCH AS "AB" "AC","AD", ETC., ARE DIRECTLY INTERCHANGEABLE AND MAY BE SUPPLIED IN PLACE OF THE "AA" CARD AN EARLIER DESIGN CANNOT REPLACE A LATER DESIGN, E.G. AN "AA' CANNOT REPLACE AN "AB".

POTENTIOMETERS ARE SHOWN IN INITIAL CONDITION SETTINGS, PRIOR TO FACTORY ADJUSTMENT.

Figure 2-2 Location and Function of Driver-Regulator Cards



NP104X905BA139

LOCATION	NAME	CAT. NO.
B	20 VOLT POWER SUPPLY	193X257AAG01
C	GATE CONTROL	193X262AAG01
D	PHASE CONTROL	193X259AAG01
E	MONITOR	193X261ABG01
F	DRIVER COORDINATION	193X260BAG01
G	STANDARD REGULATOR	193X267BAG01

ON PRINTED CIRCUIT CARDS USED IN THIS REGULATOR THE LETTERS "AA" AFTER THE BASIC CARD CATALOG NUMBER INDICATES ORIGINAL DESIGN. SUBSEQUENT DESIGNS WITH THE SAME BASIC NUMBERS & GROUP NUMBER WITH THE SECOND LETTER CHANGED, SUCH AS "AB" "AC","AD", ETC., ARE DIRECTLY INTERCHANGEABLE AND MAY BE SUPPLIED IN PLACE OF THE "AA" CARD. AN EARLIER DESIGN CANNOT REPLACE A LATER DESIGN, E.G. AN "AA" CANNOT REPLACE AN "AB".

POTENTIOMETERS ARE SHOWN IN INITIAL CONDITION SETTINGS, PRIOR TO FACTORY ADJUSTMENT.

Figure 2-2 Location and Function of Driver-Regulator Cards

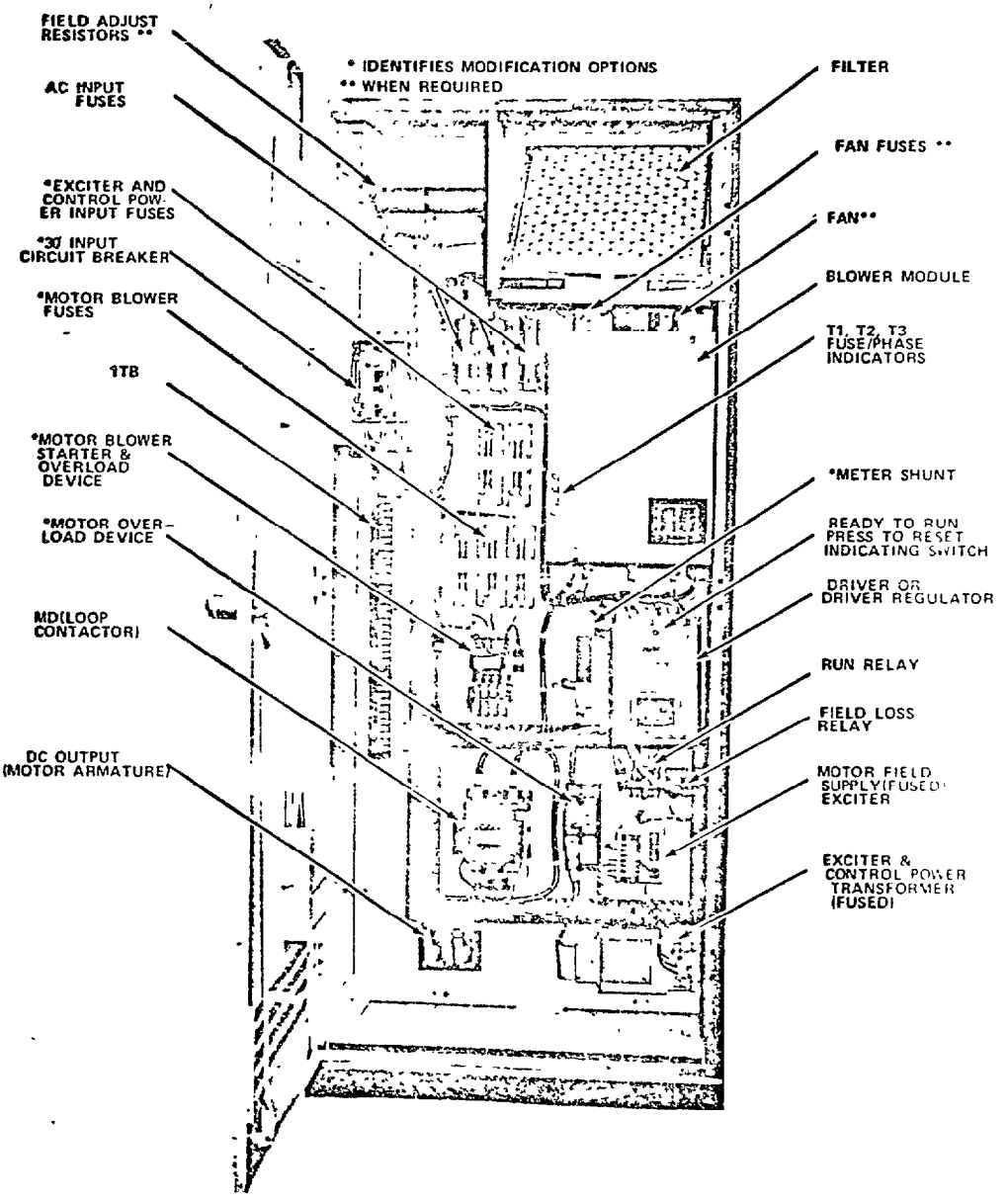


FIGURE 2-3 TYPICAL DC-3062 POWER UNIT LOCATION OF ASSEMBLIES AND COMPONENTS

SECTION III
INSTALLATION

3.1 EQUIPMENT LOCATION

Speed Variator power units equipped with filters are suitable for most factory areas where other industrial equipment is installed. Locations subject to steam vapors or excess moisture, oil vapor or chemical fumes should be avoided. If your unit has a filter and blower system, the filters should be changed or cleaned before they become clogged. Power units should be installed in a well-ventilated area not subject to excessive heat.

WARNING

EQUIPMENT SHOULD NEVER BE INSTALLED WHERE HAZARDOUS, INFLAMMABLE OR COMBUSTIBLE VAPORS OR DUSTS ARE PRESENT UNLESS IT HAS BEEN DESIGNED TO NEC CLASS I OR II ENCLOSURE SPECIFICATIONS.

3.2 TOOLS REQUIRED

The normal electrical and mechanical tool boxes maintained in most factories are all that is required for the installation of this equipment.

3.3 MECHANICAL INSTALLATION

The mechanical installation will depend upon the type of mechanical enclosure supplied. If the equipment is supplied in an open panel for installation, this has been designed to be installed in a customer supplied enclosure. If the equipment supplied is mounted in a wall enclosure, install it as per outline drawings for wall enclosures. Floor mounted equipment enclosure should be mounted as per the outline for the floor mounted enclosure. Sufficient clearance in front of the units should be allowed for the access of maintenance or repair.

3.4 ELECTRICAL WIRING AND INTERCONNECTION

All external wiring shall be in accordance with the National Electrical Code and be consistent with all local codes. All internal electrical connections between components and the Speed Variator power units were made at the General Electric factory. When installing Speed Variators, all connections should be checked for tightness. Connections may become loose in shipping or storage. A diagram showing the connections between the power unit and the related components is furnished with each equipment. All terminals to which the external connections are to be made

are numbered on the equipment as indicated on the interconnection diagram. The equipment should be wired as per the interconnection diagram and verified by continuity tests. It is recommended as each connection or wire is connected to the equipment that it be checked off on the interconnection diagram. When motor tachometer leads are connected it is recommended that feedback wiring be a twisted pair with at least six turns per foot of length. Also the speed reference input leads should be twisted.

WARNING

ALL MOTOR BASES AND EQUIPMENT ENCLOSURE HOUSINGS SHOULD BE CONNECTED TO THE FACTORY OR FACILITY EARTH GROUNDING SYSTEM. THIS PREVENTS HIGH POTENTIAL BETWEEN ENCLOSURE AND GROUND IN THE EVENT OF A MALFUNCTION.

CAUTION

POWER FACTOR IMPROVEMENT CAPACITORS ARE NOT GENERALLY RECOMMENDED FOR USE WITH THIS EQUIPMENT. IMPROPER PLACEMENT OR USE CAN CAUSE MISOPERATION. CONSULT THE GENERAL ELECTRIC COMPANY FOR SPECIFIC APPLICATION REQUIREMENTS.

CAUTION

ANY REMOTE CONTROL EQUIPMENT THAT INTERFACES WITH THIS DRIVE THROUGH A GROUNDED CONDUCTOR MUST PROVIDE PROTECTION BETWEEN THE GROUNDED CONDUCTOR AND THE DRIVE SIGNAL COMMON AGAINST GROUND CURRENTS BY EITHER:

1. EQUIPMENT HAS AN ISOLATOR CARD.
2. FUSING (½ A TYPE) IN THE GROUNDED RETURN LINE TO THE DRIVE COMMON.

THIS PROVIDES GROUND FAULT PROTECTION BETWEEN DRIVE COMMON AND REMOTE GROUNDED CONDUCTOR.

SECTION IV

STARTUP AND CHECKOUT

4.1 GENERAL

This section is written in a step-by-step approach to startup and checkout the basic drive system. If during the startup and checkout, a step cannot be performed or completed, refer to Section VI TROUBLESHOOTING, Table 6-1 or 6-2. The troubleshooting table is written to follow each startup step in sequence. Startup and checkout steps are cross-referenced in the troubleshooting table by paragraph number and indication. This section does not include instructions on special regulators or auxiliary functions or controls and indicators which may be included in individual special systems. These will be covered in the system elementary diagram notes.

Any additional limit switches or protective circuits added during installation should be checked out and operational. The basic drive has been factory tested and adjusted and a Test Data Sheet is provided to indicate factory test settings and measurements.

4.2 TEST EQUIPMENT REQUIRED

This drive has been designed so that a volt-ohm meter (VOM) and RPM measuring device is all that is required for the normal startup and checkout. In addition to the VOM, other test equipment that may be required for auxiliary functions and devices or detailed troubleshooting is listed:

Volt-Ohm Meter (VOM) Three Ranges Minimum
X1, X10 and X100; 20,000 Ohms Per Volt D-C
Sensitivity, 0 to 600V range.

Oscilloscope (Scope) DC, Triggered Sweep, 1MHZ

RPM Measuring Device (0 to 4,000 RPM Tach)

4.3 POWER-OFF CONTINUITY TEST

WARNING

VERIFY THAT THE MAIN THREE-PHASE
AC POWER INPUT TO THE SYSTEM
EQUIPMENT IS DISCONNECTED OR
SWITCHED OFF PRIOR TO CONTINUITY TESTING.

4.3.1 Perform a point-to-point continuity test for all newly installed wiring and interconnection. Continuity is defined as 1/2 ohm or less.

4.3.2 Manually operate all contactors, breakers (if provided) and relays.

4.3.3 Check that all plug-in devices (printed circuit cards and relays) are fully seated:

NOTE

DURING CHECKOUT, RECORD MEASUREMENTS AND SETTINGS ON THE TEST DATA SHEET SUPPLIED, UNDER THE USER DATA COLUMN. TDS BESIDE A STEP INDICATES AN ENTRY ON THE TEST DATA SHEET.

TDS 4.3.4 Verify that the a-c input line voltage is the proper value and frequency as per the drive unit data nameplate.

NOTE

DUE TO THE VARIATIONS OF EQUIPMENT SUPPLIED THE TEST DATA SHEET ENTRIES UNDER THE FACTORY COLUMN SHOULD BE USED FOR COMPARISON MEASUREMENTS, WHENEVER ANY DIFFERENCE BETWEEN INSTRUCTION BOOK MEASUREMENTS AND EQUIPMENT MEASUREMENTS OCCUR.

4.4 NO LOAD - POWER-ON TEST

WARNING

ELECTRIC SHOCK CAN CAUSE PERSONAL INJURY OR LOSS OF LIFE. WHETHER THE AC SUPPLY IS GROUNDED OR NOT, HIGH VOLTAGES TO GROUND WILL BE PRESENT AT MANY POINTS THROUGHOUT THE DRIVE.

No load testing is defined as the motor shaft disconnected from the end devices or no working load on the end device.

Example: Drill press bit rotating but not drilling material.

NOTE

UNDER NO LOAD OR LIGHT LOAD CONDITIONS ARMATURE VOLTAGE MAY BE LOWER AND THE CURRENT FEEDBACK SIGNAL (CFB) MAY APPEAR TO BE UNSTABLE BUT THIS IS NORMAL.

4.4.1 Initial Checkout

CAUTION

ALWAYS RETURN SPEED REFERENCE INPUT TO ZERO AND LET MOTOR COME TO A REST PRIOR TO REMOVING AC POWER.

a. Verify that the "Speed Control" is set to zero and pull the Gate Control card about one inch out from the socket using the card puller (mounted on top of driver regulator rack).

b. Apply main ac power to the drive system (the ac circuit breaker must be switched on - when supplied). The "READY TO RUN" indicator illuminates, also T1, T2, and T3 phase/fuse indicators on the power module illuminate.

When power module indicators T1, T2 and T3 are illuminated, the "READY TO RUN" indicator being illuminated verifies the following:

1. Three phase power is applied and is in the proper phase sequence.
2. Drive fuses or circuit breaker are not open.
3. No "System Fault" inputs have occurred.
4. Power Module Over Temp circuit has not activated.

If the "READY TO RUN" indicator fails to illuminate, proceed as follows:

1. Check that no indicator lights on the monitor card are illuminated except the "SYS" indicator.
2. Remove all ac power to the drive and interchange any two of the three phase input lines once. Re-apply ac power; if the indicator is still out, proceed to the Trouble-shooting Table 6-1.

c. Verify that the fan on the power module is operating or the blower (if supplied) is providing proper air flow.

TDS d. With the VOM, verify that the motor field supply is of the proper dc voltage value and polarity as per the system elementary diagrams and Test Data Sheet.

e. With the "Speed Control" set to zero (some systems) require the speed control to be at zero, through interlocking, before the "Run" relay and MD can be energized), press the "Start" pushbutton.

f. Visually verify that the MD contactor has energized.

TDS g. With the VOM, verify that the +20V and -20V power supplies (test points on the 20V Power Supply card) to common (COM) are ±1V of their rating as listed on the test data sheet.

TDS h. With the VOM, verify that the +15V, -15V and +5V power supplies (test points on Monitor card) to common (COM) are ±1V of their rating as listed on the test data sheet.

TDS j. With the VOM connected to read 0 to +20V between SR (System Reference) test point (on the Monitor card) and COM test point, slowly increase the "Speed Control" fully CW and verify that the voltage rises from 0 to approximately +20V. Return the "Speed Control" to zero.

TDS k. With the VOM still connected to SR and the "Speed Control" still at zero adjust the SMIN potentiometer fully CW and verify that the voltage is the same approximate value as listed on the test data sheet. Turn the SMIN potentiometer fully CCW.

TDS l. With the VOM connected to read 0 to -10V between TR (Timed Reference) test point and COM, quickly turn the "Speed Control" fully CW and verify that the voltage rises from 0 to the approximate value on the test data sheet. The rate of rise is adjustable by the TIMR potentiometer from 3 to 30 seconds or when a jumper is added between G16 to G17 the adjustable time range is 0.5 to 3 seconds.

m. With the "Speed Control" still fully CW and still monitoring TR with the VOM, press the "READY TO RUN" (RTR) switch indicator. The VOM reading will immediately drop to 0V and MD contactor will open. Pressing the RTR switch indicator causes the "Fault" relay to de-energize which phases back the driver and opens up the MD. *

n. With the "Speed Control" still fully CW, with the VOM verify that 0 to -1V is measured at DR (Driver Reference) to COM test points. With the VOM also verify that "PCR" (Phase Control Reference) test point is 0V. Return "Speed Control" to zero.

TDS o. With the VOM connected to read 0 to +20V between DR (Driver Reference) test point and COM, turn the "Speed Control" fully CW, press the Start button and verify that the voltage rises from 0 to +10V to +20V range. With the VOM verify that PCR (Phase Control Reference) is greater than +8 volts. Return the "Speed Control" to zero.

p. Switch off/disconnect AC input power to the drive and plug in the Gate Control card and make sure it is firmly seated.

q. Set the "Speed Control" full CCW and reapply AC power to the drive. While observing the motor shaft for proper direction of rotation press the START button and turn "Speed Control" slowly CW until shaft just begins to rotate. Immediately press the STOP button. If incorrect motor rotation is observed switch off AC input power to the drive and reverse the armature leads A1 and A2 at the drive power terminal board.

* Omit if regulator card is not furnished.

r. If Tachometer Feedback has been supplied, with the VOM connected to read +20V between SFB (System Feedback) and COM and while observing the VOM press the START button and verify that a positive voltage is present when shaft is rotating. Press STOP button. If voltage was not positive reverse the tachometer leads at the drive terminal board. Return the "Speed Control" to zero.

s. While monitoring motor speed press the START button and adjust the SMIN (System Minimum) potentiometer for desired minimum motor RPM.

t. Turn the "Speed Control" fully CW. Adjust SMAX (System Maximum) for desired maximum motor RPM. Press the STOP button.

u. With the "Speed Control" fully CW measure (in seconds) the acceleration time from zero to top speed when the START button is pressed. Adjust for desired acceleration time using the TIMR (Time Range) potentiometer. Press the STOP button.

v. When an APR (Auxiliary Preset Reference) such as Jog or Thread has been supplied put the drive in APR mode and press the START button and adjust the APR potentiometer for the desired RPM. Press the STOP button and select the normal running load. *

4.5 NORMAL RUNNING FINAL ADJUSTMENT

TDS This part of the Startup verifies the drive is operating smoothly under varying load and reference conditions. The current limit (ILIM) potentiometer has been factory set at 150% unless special drive requirements dictated another setting - check the test data sheet for the exact factory setting. The Load Regulation (LREG) has also been factory adjusted for 0% load regulation at 2/3 motor speed, unless otherwise indicated on the test data sheet. The Response (RESP) and Motor Damping (DAMP) potentiometers have been factory set for smooth drive operation but may require further field adjustment for optimum drive performance.

a. If field adjustment is required, always adjust the RESP potentiometer first.

NOTE

THE ADJUSTMENT OF THE DAMP AND LREG POTENTIOMETERS ARE NORMALLY CLOSE TO THE CENTER OF THEIR ADJUSTMENT RANGE (WIPER ARM SET TO MIDDLE). MIS-ADJUSTMENT OF THESE POTENTIOMETERS CAN CAUSE DRIVE INSTABILITY.

* Omit if regulator card is not furnished.

Verify proper drive operation under all normal operating conditions. All special purpose equipment/controls should be set at this time.

SECTION V
MAINTENANCE

WARNING

ELECTRIC SHOCK CAN CAUSE PERSONAL INJURY OR LOSS OF LIFE. IF POWER OFF MAINTENANCE IS BEING PERFORMED, VERIFY ALL POWER TO THE DRIVE SYSTEM IS SWITCHED OFF OR DISCONNECTED. RECOMMEND POWER SWITCHES BE RED TAGGED DURING POWER OFF MAINTENANCE.

5.1 MECHANICAL

The mechanical maintenance required for the drive system is divided into two basic units; power unit and motor. The power units only mechanical maintenance is checking and changing the air filter (if supplied) as required.

Motor maintenance is covered by the motor instruction book supplied with the motor and should be followed in all cases.

5.2 ELECTRICAL

Power off (every six months)

a. Check all power electrical connections for tightness.
b. Look for signs of poor connections or overheating (arcing, discoloration).
c. Manually check cooling fans for easy rotation.

5.3 DC-3062 SCR POWER MODULE

5.3.1 Removal of Heatsink Assembly from Conversion Module Case

a. Remove the front cover from the module by removing the two retaining screws.
b. Remove the Pulse Transformer Card SCR Gate and Cathode leads from stab-on terminals. Remove the two retaining screws of the Pulse Transformer Card Assembly (red cover) and let it hang below the module supported by the wire harness.
c. Remove Heatsink Assembly top and bottom connection bolt and center retaining nut and slide Heatsink Assembly (including black insulation cover) from module.

5.3.2 Replacement of Heatsink Assembly

a. Repeat the above steps in reverse by installing removed hardware and reconnecting all wires.

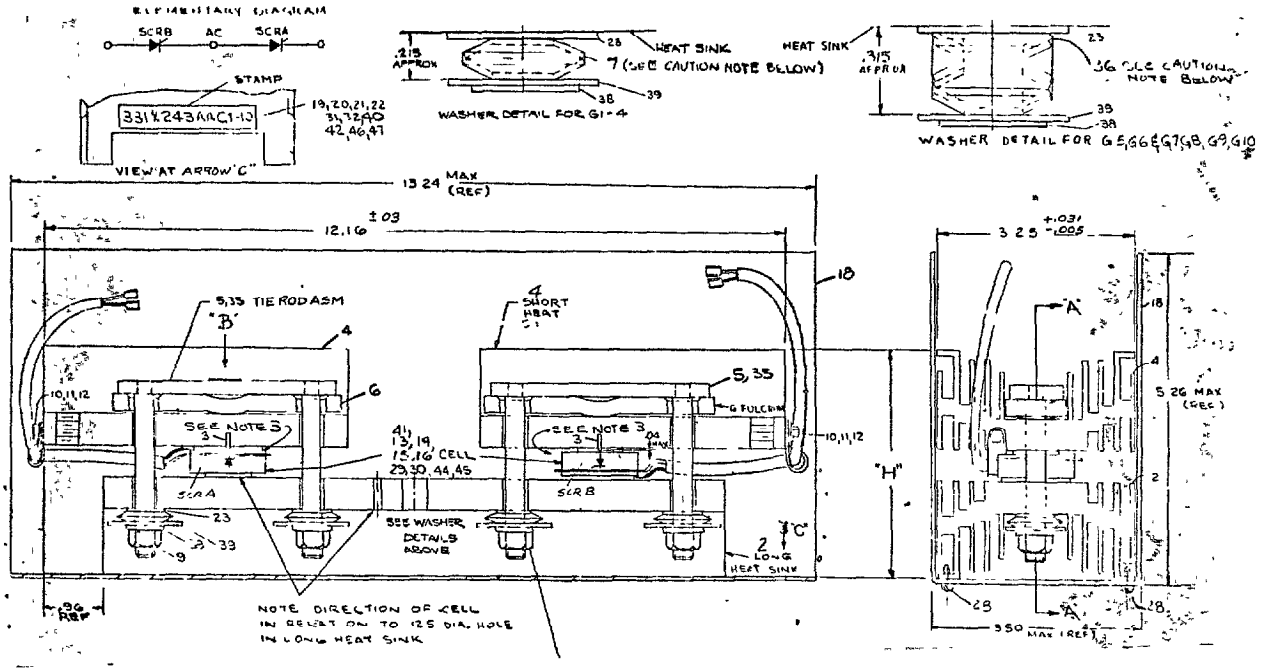
5.4 SCR REPLACEMENT PROCEDURE

In the event of an SCR cell failure the following steps are required for replacement of the press pak cell on the heatsink assembly.

If minimized down time is a critical factor, it is recommended that one heatsink assembly (one assembly consisting of two cells mounted on heatsinks with insulation cover) be an "on the shelf" spare.

5.3.1 Heatsink Assembly

a. Remove the two nylon screws (part 28) from the back of the black insulating cover (part 18) and remove the cover. Reference heatsink pictorial for parts location and identification.



PART	NAME	PART	NAME
1	ASM DIAG	11	SCREWS
2	HEAT SINK	12	WASHER
3	ROLL PIN	13	SCR
4	HEAT SINK	17	ASM WASHER
5	TIE ROD	18	INSUL COVER
6	FULCRUM	23	WASHER
7	ASM WASHER	28	SCREW
9	NUT	38	WASHER
10	CLAMPS	39	PLATE

b. Remove the associated SCR leads cable from the cable clamp for the failed cell (parts 10, 11 & 12).

c. SCR Cell Replacement

1. Place heatsink assembly with green tie rods (part 5) facing down and remove the nuts (two only) of the failed cell subassembly (part 9). This allows the tie rod to slip down to rest on the working surface.

2. Remove the failed cell and clean the heatsink surfaces with a soft cloth and inspect the surfaces to make sure they are smooth.

3. Take the new replacement cell, twist the cell leads together, place white tubing over twisted cell leads and crimp on the female spade terminals and apply a small amount of "Burndy Penetrox A" (or equivalent joint compound) to the small hole on each side of the cell (with a dab on top) so that under pressure the compound will cover only the raised center circular surface on each side.

4. Place new cell in the same orientation as the failed cell and place on the roll pin (part 3) of the heatsink so the roll pin is in the center hole of the cell.

5. Place the two nuts (part 9) back on the tie rod (with parts 23, 7 or 36, 39 and 38 on the tie rod as indicated) and tighten each nut finger-tight so the threads showing are approximately the same on both sides.

6. Check that cell hole is still over the roll pin.

7. With the nuts finger-tight, use a wrench and tighten each nut 1/6th of a turn (alternate between nuts) until the nuts have completed 1-5/6 turns each for the 1/2" thick cell or 2-3/6 turns for the 1" thick cell. Inspect the assembly to make sure that the heat sinks are aligned equally and parallel with each other and the long heatsink.

SECTION VI
TROUBLESHOOTING

6.1 GENERAL

These troubleshooting procedures assume that the system has been installed and checked out and has been operating properly prior to a malfunction. Fast efficient troubleshooting of the drive system is based on a thorough knowledge of the theory of operation. All measurements should be compared with checkout values. If temporary malfunctions/problems occur, then seem to disappear or self-correct themselves, then the incoming three phase a-c power should be checked for proper amplitude and phase at times of peak loading in the facility/building. Should repeated fuse and/or SCR failures occur, the three phase a-c input power should be checked for high level spikes or extreme short duration power variations. During troubleshooting when a card or subassembly is found or suspected of being bad, it is recommended that prior to replacing the card/subassembly, the inputs be checked for proper values. This will exclude the chance of further damage to the replacement item due to causes beyond the suspected item.

6.1.1 Electrical

The electrical troubleshooting procedures are divided into three parts; Drive System not operating, Drive System operating but not properly and System Testing. The following checklists will help locate the malfunction with a minimum of effort when a logical approach/analyzation of the problem is considered. If in troubleshooting, the inputs are found to be good, but the outputs are bad, then the malfunction is assumed to be located. To use the checklist correctly, first select the proper checklist depending on the type malfunction indicated - Operating or No Operating. Using this checklist, locate the type of malfunction indicated under the left-hand column, "Indication". The right-hand column "Check/Adjust/Replace" lists, in logical order, the steps to be taken. When a step or action is completed and the malfunction still occurs, proceed to the next step. If the step located the problem area, troubleshoot, isolate and correct the malfunction. Retune /Adjust as required using Section IV.

CAUTION

REMOVE POWER PRIOR TO REMOVING OR INSERTING PRINTED CIRCUIT CARDS. DO NOT CONNECT TEST EQUIPMENT DIRECTLY TO BACK PLANE SOCKET PINS - USE THE SELECT (SEL) TEST JUMPER & TEST POINT. FAILURE TO REMOVE POWER CAN CAUSE EQUIPMENT DAMAGE WHEN MAKING OR BREAKING ELECTRICAL CONNECTIONS.

TABLE 6-1 DRIVE SYSTEM NOT OPERATING

INDICATION	CHECK/ADJUST/REPLACE
T1, T2 or T3 indicators fail to illuminate. (4.4.1b)	1. Verify that all three input phases are present and are as listed on the data nameplate. 2. Verify that power input is present at the input to the conversion module, T1,T2,T3.
RTR fails to illuminate & SYS indicator is illuminated. (4.4.1b)	1. Improper phase sequence, reverse any two input phases to drive, once. 2. Verify that less than +5V is present on 1TB15 of the driver regulator. 3. Verify that -20V is present on power supply test point. 4. Verify that DC link fuses (if supplied) have continuity. 5. Replace monitor card.
RTR fails to illuminate & no monitor indicator illuminates. (4.4.1b)	1. Verify that 115VAC is present on DPA terminal board H1 & H2. 2. Verify that ±20V is present on power supply test point. 3. Check power supply fuses. NOTE VERIFY THAT A SHORT CIRCUIT OR OVERLOAD OF THE ±20V BUSSES DOES NOT EXIST PRIOR TO REENERGIZING THE DRIVE.
RTR fails to illuminate & TEMP indicator is illuminated. (4.4.1b)	1. Verify that conversion module fan is rotating. 2. Verify that abnormal mechanical loads are not present: i.e., excessive friction, shaft misalignment, etc. 3. Verify that drive duty cycle has not exceeded rating. 4. Verify that incoming air to conversion module is less than 40°C. 5. Replace monitor card.
RTR fails to illuminate & IOC indicator illuminates.	1. Check drive mechanical connection for binding or any indication of transient shock loading. 2. If problem persists, monitor incoming line for excessive fluxation in voltage.

TABLE 6-1 DRIVE SYSTEM NOT OPERATING

INDICATION	CHECK/ADJUST/REPLACE
MD contactor fails to energize (4.4.1f)	1. Verify that the voltage is available to pick up contactor. 2. Verify that the voltage is available to pick up associated pilot relays. 3. Verify that field loss relay has picked up. 4. If defective contact, switch, relays or control logic, replace.
±20V is not present on power supply test points. (4.4.1g)	1. Verify 115VAC is present on DPA terminal board. 2. Verify that power supply fuses are not open. 3. Verifv that +30V is present at termi point pin B20 and -30V is present at termi point pin B10. 4. Replace 20V power supply card.
±15V or 5V power supplies are not present. (4.4.1h)	1. Verify that ±20V is present on power supply card test points. 2. Remove phase control & gate control cards and check for voltage again; if not present, replace driver coordination card. 3. Insert phase control card back into drive, if voltage is not present, replace phase control card. 4. Insert gate control card back into drive; if voltage is not present, replace gate control card.
Voltage at SR does not change as speed control varies (4.4.1j)	1. Verify that electrical connection between speed control and drive is correct. 2. Replace speed control.
Voltage at TR fails to change when speed control is changed & Start button has been pressed. (4.4.11)	1. Verify that voltage on driver TB20 & 18 is less than -20V. 2. Replace Regulator Card.

TABLE 6-1 DRIVE SYSTEM NOT OPERATING

INDICATION	CHECK/ADJUST/REPLACE
DR fails to go negative when Stop button has been pressed. (4.4.1n)	1. Verify the voltage on driver TB18 is greater than +20V. 2. Replace regulator card.
DR or PCR fails to go positive when speed control is turned CW & Start button has been pressed. (4.4.1o)	1. Verify that voltage on driver TB18 & 20 is less than -20V. 2. Rotate ILIM potentiometer 1/8 turn CW. 3. Replace regulator card.
Shaft will not rotate with reference potentiometer turned fully CW and Start button pressed. (4.4.1q)	1. Verify the voltage on 1CST is less than 1V. 2. Turn ILIM potentiometer 1/8 turn CW. 3. Check for some armature voltage and current at VFB and CFB. 4. Check for mechanical binding. 5. Refer to Table 6-3. 6. Verify that PCR is greater than 2V; if not, replace driver coordination card. 7. Verify that voltage on termi point pin E 6 is less than .5V, if not, replace monitor card. 8. Verify the voltage on termi point pin F6 is greater than 2V, if not, replace driver coordination card. 9. Replace phase control card. 10. Replace gate control card.
SFB does not go positive as motor shaft rotates (4.4.1r)	1. Reverse tachometer leads (if supplied) at drive terminal board. 2. Verify that voltage is present at PFB & NFB on driver terminal board points 6 & 9, when shaft is rotating, if not, verify electrical connections between tachometer & drive and/or replace tachometer. 3. Replace regulator card.
Unable to adjust drive to maximum speed with SMAX potentiometer (4.4.1t)	1. Verify AC input voltage is within tolerance. 2. Verify field voltage is within tolerance. 3. Verify that feedback voltage between PFB and NFB is of proper magnitude for the proper range selected on regulator card; if not, change range on standard regulator card. 4. Replace regulator card.

TABLE 6-1 DRIVE SYSTEM NOT OPERATING

INDICATION	CHECK/ADJUST/REPLACE
Drive will not function in APR Mode. (4.4.1v)	1. Verify that MD is closed. 2. Verify that voltage on driver terminal board TB18 & 19 is less than -20V. 3. Replace regulator card.

TABLE 6-2 DRIVE SYSTEM OPERATING

INDICATION	CHECK/ADJUST/REPLACE
Drive does not maintain correct speed. Motor runs too fast.	1. Verify that SFB is a positive voltage. 2. Verify feedback voltage at PFB and NFB is compatible with feedback range selected on regulator card. 3. Verify that DR is a negative voltage, if not, replace regulator card. 4. Verify that VFB is a negative voltage, if not, replace driver coordination card. 5. Verify that PCR is zero volts, if not, replace driver coordination card. 6. Refer to Table 6-3.
Motor cannot reach desired RPM.	1. Verify that feedback voltage is compatible to voltage range selected on regulator card. 2. Verify that the drive is not in current limit. 3. Verify that SMAX potentiometer is properly adjusted. 4. Refer to Table 6-3.
Drive is unstable.	1. Oscillation is not periodical. 2. Oscillation is periodical (sine wave) and proportional to speed. 3. Oscillation is periodical and is not proportional to speed. Causes a. The Oscillation is not periodical. This is usually caused by noise. Check tach voltage and reference voltage for ripple. If shielding is used, see that shield grounding is done at one point only. b. The Oscillation is periodical and is proportional to speed. This is usually caused by a mechanical unbalance in load or a fault in the tachometer mounting. c. The Oscillator is periodical and is not proportional to speed. In this case, the fault is usually in the regulator. 1. Readjust "RESP" potentiometer 1/8 turn CCW (on the standard regulator card). 2. Turn DAMP potentiometer CW in small steps (up to 1/4 turn). 3. Turn LREG potentiometer slightly CW (up to 1/8 turn). (COMP)

TABLE 6-3 DETAILED SYSTEM TESTING (Oscilloscope Required)

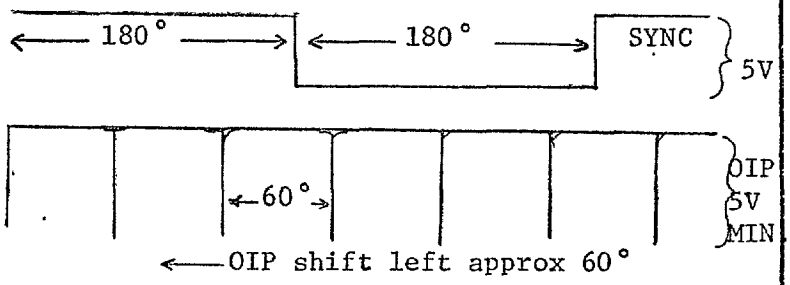
INDICATION	CHECK/ADJUST/REPLACE
Drive is not operating properly	CAUTION DO NOT USE EXCESSIVE FORCE OR BEND THE PINS WHEN CONNECTING JUMPERS, THEY CAN BREAK. 1. Remove the AC Power 2. Jumper from pin G2 to pin G29 on the Regulator card socket. 3. Jumper from pin G21 to pin G15 4. With AC power applied and the MD loop contactor open (do not press Start button) the following signals should increase from zero to the indicated value as the Speed Control is turned fully CW: SR 0 to +20V (if not, check input circuit) TR 0 to -10V (if not, replace Regulator card) DR 0 to +10V (if not, replace Regulator card) PCR 0 to +5V (if not, replace Driver Coordination card) 5. With the oscilloscope (scope) monitoring OIP verify that the pulses advance to the left as the Speed Control is turned CW as indicated below. Scope settings are: 5V/CM and .2MS/CM.  If OIP is not as shown or the pulses do not uniformly advance, replace the Phase Control card. 6. With AC power applied and the scope monitoring 1F1, then 1F2, 1F3, 1F4, 1F5 and 1F6 and with the Speed Control fully CCW, verify that the firing burst are as below: Scope settings are: 5V/CM and 2MS/CM.

TABLE 6-3 DETAILED SYSTEM TESTING (Oscilloscope Required)

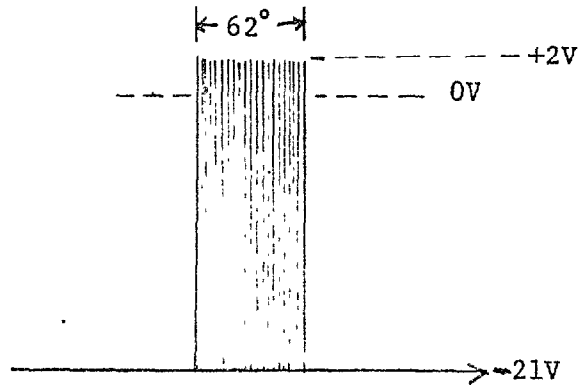
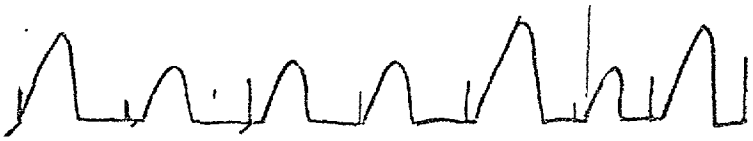
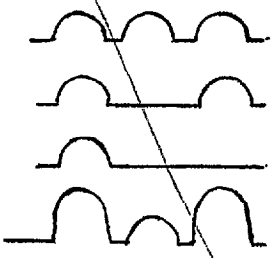
INDICATION	CHECK/ADJUST/REPLACE
	 1F1 thru 1F6 in maximum phase back condition, zero speed reference. As the Speed Control is turned CW, 1F1 thru 1F6 will evenly advance to the left to a width of 120°; if not, replace the Gate Control card. 7. With AC power applied, press the Start button and turn the Speed Control halfway CW and with the scope monitoring CFB, the Current Feedback Signal should be as shown below: Scope settings are: .2V/CM and 2MS/CM (no load)  CFB at rated load will be approximately 2.5V. If a pulse is missing this indicates that either a pulse amplifier or SCR is defective. Normally when an SCR shorts it will fail one or two AC input fuses. 8. Be sure to remove all added jumpers to return to normal running condition.

TABLE 6-2 DRIVE SYSTEM OPERATING

Indication	Check/Adjust/Replace
Motor/Machine unstable/erratic Motor/Machine stops during operation	10. Uncoupled motor from load/machine and recheck for instability/erratic operation of motor. 1. Check control transformer fuse. 2. Check power supply fuses. 3. Check TM indicator. 4. Check overload relay (OLD).(if supplied) 5. Check any external/auxiliary protective devices. 6. Check for IOC trip. 7. Check for proper input reference. 8. Check motor blower motor for correct rotation.
SCR not firing/ conducting.	Check for the following signals using a scope: 1. Verify that all three current feedback pulses (per direction) are present and of equal amplitude on TP7 as indicated below:  proper SCR firing. one SCR not firing. two SCR's not firing. unbalanced firing. 2. With Test Switch #1 in Center position and Test Switch #2 in Down position, verify that Firing Signals are present on the output of each Pulse Transformer card on the SCR module (white wire gate - red scope probe common).

6.1.1.1 Checking SCR's

WARNING

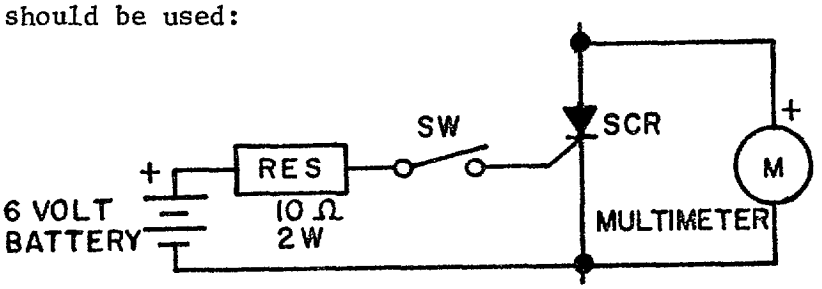
ELECTRIC SHOCK CAN CAUSE PERSONAL INJURY OR LOSS OF LIFE. WHETHER THE AC SUPPLY IS GROUNDED OR NOT, HIGH VOLTAGES TO GROUND WILL BE PRESENT AT MANY POINTS THROUGHOUT THE SYSTEM.

a. Disconneet the AC power and make sure the DC armature loop contactor (MD) is open.

b. Using a multi-meter selected to read ohms on the times-1K scale, check the forward and reverse resistance of each individual SCR cell. This is done by reading across power terminals T1 and DC1, T2 and DC1, T3 and DC1, DC2 and T1, DC2 and T2, and DC2 and T3. (See conversion module elementary diagram.) Good or faulty SCR's will give the following typical readings:

SCR Description	Forward Reading	Reverse Reading
Good SCR	100K to Infinity	100K to Infinity
Shorted SCR	Zero	Zero
Inoperative SCR	1 to 2K	100K to Infinity
Open SCR	100K to Infinity	100K to Infinity

c. Since an open SCR will give about the same resistance reading as a good SCR, another method must be used to find this type of fault. It should be pointed out however, that practically all cells fail by shorting and very few by opening. If an open SCR is suspected, or if it is desired to check the switching operation of an SCR, the following circuit should be used:



The multi-meter is selected to read ohms on the 1K scale, and is connected to read the forward resistance of the SCR. When switch SW is closed, the forward resistance of a good SCR will change from a high value (100K to infinity) to a low value (1 to 10K). When the switch is opened, a good SCR will revert to its high forward resist-

ance or blocking state, if the holding current (Multimeter battery) source is momentarily removed. A faulty SCR will not switch, remaining in either an open or a conducting state.

d. If any SCR's are suspected of being faulty from the above resistance checks, the SCR conversion module should be removed from the case. After the SCR pigtail (cathode) and gate leads have been disconnected, recheck the forward and reverse resistances before replacing the SCR heat sink assembly. This should be done before any SCR is definitely classified as damaged or faulty, since a fault in another SCR or another part of the circuitry can produce a faulty reading from a good SCR before it is disconnected from the circuit.

6.1.2 Mechanical

Mechanical troubleshooting of the system is very limited. The following areas, mechanical in nature, would result in symptoms that would tend to lead you in the direction of an electrical problem but are solely mechanical:

1. Mechanical binding.
2. Improper equipment ventilation causing overheating conditions leading to electrical component failure.
3. Foreign matter intrusion into equipment causing arcing, shorts, poor connections or overheating.
4. Loose screws or bolts due to vibration causing bad connections, binding, arcing or improper connection.
5. Lack of regularly scheduled maintenance inspection.

SECTION VII
SPARE PARTS RECOMMENDATION

7.1 GENERAL

A realistic "on hand" spares stock coupled with the Speed Variator low cost card exchange plan will lead to faster resolution of down time of the equipment in case of malfunction. By having on hand spare parts, there is no extended down time after the problem has been located awaiting parts that must be ordered and shipped from the factory. The concept of easily removable (plug in) printed circuit boards is a fallacy if it only takes a few minutes to discover the defective assembly but hours to order and procure a replacement. Therefore, from the standpoint of keeping the equipment/machine operating with a minimum of down time, readily available on hand spares are a must. The advantages coupled with the "Card Exchange Plan" are three fold:

1. Minimum down time due to not awaiting part arrival.
2. The lower cost of the "Card Exchange Plan".
3. No cost for time and special test equipment to troubleshoot, repair and testing of failed cards. The repair and testing of printed circuit cards takes special handling techniques and test equipment that most facilities do not have.

The proper evaluation of profits lost per hour of down time of the machine/system versus the cost of on hand spare parts and the time saved is a readily available figure. A high volume machine output would therefore require a larger spare parts stock to insure minimum down time. For further information on the Speed Variator Department Card Exchange Plan, contact your local General Electric Company Installation and Service Engineering Component or Speed Variator Department, Erie, Pennsylvania.

7.2 RECOMMENDED SPARE ASSEMBLIES, SUB-ASSEMBLIES AND PRINTED CIRCUIT CARD/BOARDS

NOTE

WHEN ORDERING SPARE PARTS
BE SURE TO GIVE COMPLETE
PART NUMBER, AND ASSEMBLY
NAME TO INSURE FAST AND
EFFICIENT SERVICE.

The following is a list of recommended spare parts:

Assembly/Sub-assembly	Quantity
±20 volt DC Power Supply Card	1
Pre-amplifier Card	1
Driver Coordination Card	1
Phase Sub-module Cell Panel (heat sink included)	2
Auxiliary Function Card	1

7.3 RECOMMENDED SPARE COMPONENTS

Component	Quantity
Line Fuses	4
*Power Supply Fuses	2
Other Fuses	1 of each
Command/Control Relays (small/plug in)	1 each type

NOTE

ALL MOTOR SPARE PARTS AS PER RECOMMENDATION OF THE DC MOTORS INSTRUCTION BOOK INCLUDED IN THE DOCUMENTATION SUPPLIED SHOULD BE ON HAND.

*There are two spare fuses mounted on the heat sink of the power supply.

Assembly/Sub-assembly	Quantity
±20 Volt DC Power Supply Card	1
Regulator Card	1
Driver Coordination Card	1
Phase Control Card	1
Gate Control Card	1
Pulse Transformer Card	1
Phase Sub-module Cell Assembly (heat sink included)	2
Monitor Card	1

7.3 RECOMMENDED SPARE COMPONENTS

Component	Quantity
Line Fuses	4
*Power Supply Fuses	2
Other Fuses	1 of each
Command/Control Relays (small/plug in)	1 each type

NOTE

ALL MOTOR SPARE PARTS AS PER RECOMMENDATION OF THE DC MOTORS INSTRUCTION BOOK INCLUDED IN THE DOCUMENTATION SUPPLIED SHOULD BE ON HAND.

* There are two spare fuses mounted on the heat sink of the power supply.

General Electric Company • Speed Variator Products Department • Erie, Pennsylvania 16501

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